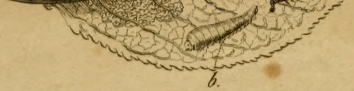
Esteemed friend Judge Lowell.



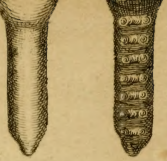


Fig. 8. a.

Fig. 9.

Fig. 10.

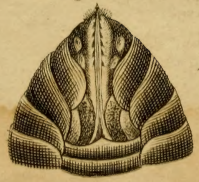


Fig. 11.

Fig. 13.

Fig. 12.

Fig. 14.

Fig. 15.

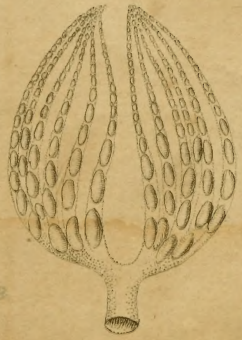
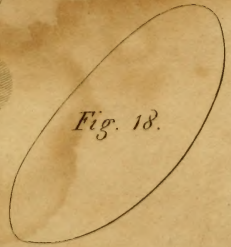


Fig. 16.

Fig. 17.

Fig. 18.



B. S. N. H. DUPLICATE
Boston Soc. of Nat. Hist. from Dr. B. J. Jeffries. Feb 7 16 60

NATURAL HISTORY

OF THE

SLUG WORM.

NATURA NUSQUAM MAGIS QUAM IN MINIMIS TOTA EST.
Plin. lib. xi. cap. 2.

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NATIONAL MUSEUM

By William Dandridge Peck,

Member of the Agricultural and Hiſtorical Societies and A. A. S.

By order of the Massachusetts Agricultural Society.

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Natural History of the Slug Worm.

By WILLIAM DANDRIGE PECK,
MEMBER *of the* AGRICULTURAL *and* HISTORICAL SOCIETIES, & A.A.S.

Natura nuſquam magis in minimus tota eſt.
PLIN. LIB. XI. CAP. 2.

Addreſſed to JONATHAN MASON, *Eſq. Correſponding Secretary to the* MASSACHUSETTS AGRICULTURAL SOCIETY.

SIR,

IN every branch of agriculture, and particularly that which compriſes gardening, we cannot but take notice of inſects, which inhabit the plants we raiſe: The variety of trees which you cultivate, muſt have preſented to your obſervation many inſects, that the diligence of your gardener is ſcarce able to repel.

MOST inſects, from the time of their being excluded from the egg, till they ceaſe from feeding, wear a different form from that which they put on in their perfect ſtate. The name of Larva, has been given to the form under which they firſt appear, and in which they are moſt injurious to trees and plants. At the termination of this firſt period, they become contracted, ſome before, and others after, they have formed around them a covering, with materials furniſhed by themſelves. In this ſecond period they have received the name of Pupa and Chryſalis. In this ſtate the inſect remains, till every part of its new form has acquired its full growth, and at the end of this period it leaves its narrow priſon, and may be figuratively ſaid to have arrived at the age of puberty.

CATERPILLARS

CATERPILLARS are exceedingly numerous and generally known; there are however other larvæ, which bear a conſiderable reſemblance to them; but are transformed to inſects widely different: Naturaliſts have called them falſe caterpillars. The largeſt of theſe that I have ſeen, were upon the White Birch and the Willow. Thoſe which inhabit the willow are common enough: They are ſmooth and black, with a ſeries of yellow ſpots on each ſide, along the whole length of the body. They feed in ranks arranged along the edges of the leaves, and throw themſelves into very odd attitudes. Examined with a magnifier, they are found to have the ſix firſt feet, armed with a ſingle claw, like the caterpillar; but the other feet are more numerous, and inſtead of being furniſhed with a number of little hooks, as in the caterpillar, are only retractile prominences terminated by a ſoft, ſmooth, and rounded ſurface.

I GIVE you this deſcription, Sir, and refer you, for the obſervation of the ſeveral particulars of it, to the black larva which infeſts the willow, as it is large enough to be eaſily examined, becauſe the Slug, which ſeems at preſent to threaten the deſtruction of ſome of our beſt fruit-trees, is of the ſame family.

IT is ſaid to be about eight or ten years, ſince the Slug was firſt obſerved in gardens, in the county of Eſſex, from whence it is ſuppoſed to have ſpread.

HAVING been in the habit of frequently viſiting my trees, in order to deſtroy the canker and web-worms, or other inſects which infeſted them, I think I ſhould have ſeen the Slug if it had been in my garden; but it was not till the 8th of July, 1796, that I ſaw any on my trees: I will not however aſſert, that it did not inhabit them before, in ſuch ſmall numbers as to elude obſervation.

ON the 12th of July I plucked ſome leaves on which the Slugs were feeding; and having filled a glaſs veſſel with light earth, laid the leaves upon it; by the 19th theſe had all ceaſed to feed, and having thrown off the ſlimy ſkin, appeared in a yellow one, and deſcended into the earth. A few which had entered the earth at the ſide

of

of the veſſel, afforded me an opportunity to obſerve, that when they had attained a certain depth, they, by moving their body, preſſed the earth equally on all ſides, and thus ſmoothed the cavity, which they then lined with an adheſive ſubſtance, reſembling Lac in colour, and of the nature of ſilk; though not fibrous. To this ſubſtance the earth cloſely adheres. The cell is rather of an oval form, externally of a rude appearance, internally ſmooth, and in ſome degree gloſſy.

As ſoon as the cell was compleated, they remained contracted for ſome time, till the yellow ſkin was thrown off and the pupa ſtate ſucceeded. In ſixteen days after their deſcent, one end of the cell was broken off tranſverſely, and through the opening, thus made, the perfect inſect aroſe.

It was a ſmall black fly, a little more than a quarter of an inch in length, with four tranſparent wings. It is to be noted, that this was the firſt hatch of the year 1796, which had now paſſed through all its ſtages. The fly is repreſented at *fig.* 8. *a.* and magnified at *fig.* 8. *b.*

On the 7th of Auguſt the eggs, placed in the leaves by the flies of this firſt hatch, began to be ſeen, and on the 16th I firſt ſaw the larvæ of the ſecond race. A number of the ſmalleſt of theſe were collected, and I found that they began to ceaſe from feeding on the 11th of September; a term of 26 days from their being hatched; and by the 19th of the ſame month there were none any where to be ſeen.

These are the principal obſervations I was able to make that year.

Having acquired a certain knowledge of the fly and the eggs, I determined in the ſpring of 1797, to watch their progreſs very carefully. Some young cherry trees, five or ſix feet high, afforded me good ſubjects for this purpoſe. From the firſt unfolding of their leaves, I examined them every day. It was the 2d of June before I ſaw a fly; but eggs had been depoſited the day before.

On the 6th, as I was ſtanding by a ſmall tree, a fly came and reſted on a leaf before me, and while I was looking

ing at it, she raised her head a little, bending down the hinder part of her body, reclined a little on one side, and throwing out a small sting, pierced the leaf obliquely, and by degrees separated the upper membrane from the fleshy part of the leaf; making a circular incision of about half a line in diameter: then withdrawing the sting a little, forced an egg into the aperture. I marked this leaf, by putting a thread loosely round it, in order to determine the precise time which would elapse before the egg was hatched. Examining it from time to time with a magnifier, I found it encreased in bulk, and from a long oval, approached a spherical form, as represented at *fig.* 1. *a.* & *b.*

On the tenth day I could perceive, through the membranes of the leaf and egg, the eyes of the larva, as at *fig.* 1. *b*; and on the 20th of the month it appeared on the leaf and began to feed. This was the fourteenth day from the deposite of the egg, and the result accorded with the appearance of the other Slugs that first shewed themselves on the 15th of the month from eggs deposited on the 1st.

From the 11th to the 19th the flies appeared in the greatest numbers, so that I caught 50 or 60 in a short time while standing by the trees. They have not the timidity of other insects, and may be taken with very little trouble. When the fly is about to place an egg in a leaf, after she has begun to make the incision, the leaf may even be cut off, and with a magnifier of about 3 4ths of an inch focus, this very amusing operation, which is performed in less than a minute, may be distinctly observed through the transparent skin of the leaf. The incision is generally made on the under side of the leaf, without wounding the skin of the upper side; the egg being forced in raises the upper skin, and the spot appears like a small blister; the health of the leaf and the circulation of its sap, appear to be in no wise injured; the egg is kept moist, and defended from the action of the air and rain; but has all the benefit of light and heat.

The skin of the egg is soft and susceptible of distention, and in order to preserve these qualities, it seems necessary, that

that it ſhould be placed in contact with the ſap-veſſels of the leaf, which may, perhaps, in ſome ſort, contribute to the nouriſhment of the embryo larva. If the cuticle of the leaf is carefully raiſed, the young larva may be ſeen, rolled in a ſpiral form, as at *fig.* 1. *b.* and white; a ſlip of a leaf in the vial, with the aſſiſtance of a glaſs, will afford you an opportunity to obſerve it in this ſtate.

Soon after emerging from the bliſter a viſcid exudation takes place which covers the whole upper ſurface of the larva with a ſlimy coat of an olive colour. In this, as well as in its tardy motion, it reſembles the Slug or Snail, whoſe name has been applied to it. This coat retains its humidity although expoſed to the fierceſt heat of the ſun: it is probably a defence againſt its enemies, and anſwers the further purpoſe of ſupport when removed from its natural poſition. The olive colour in ſome is very deep, in others more dilute and inclining to a dirty yellow.

On firſt quitting the egg the larva is nearly white, the head brown and apparently large in proportion to its body, as in *fig.* 1. *c.* where it is delineated both of its natural ſize and magnified.—In the courſe of twenty days it throws off four ſkins at nearly equal periods; it remains in the fifth or laſt viſcous ſkin ſix days, and acquires its full growth (*fig.* 2. *a.*); it then quits this fifth ſkin which is left adhering to the leaf (*fig.* 2. *c.*), and appears in a clean yellow one, entirely free from viſcidity, and has ſo different an aſpect that it would not be ſuppoſed to be the ſame larva (*fig.* 2. *b.* and *fig.* 5.)

After reſting ſome hours, it proceeds ſlowly towards the earth, creeping down the leaf-ſtalk and along the body of the branch—I did not watch its tedious progreſs to the trunk; but believe, when they arrive at the rough bark, they loſe their foot-hold and fall; as I have never ſeen any on the trunk, which muſt be covered with them at the ſeaſon of their deſcent if they were able to move on rough ſurfaces.

They do not all proceed thus regularly; for I have obſerved, that if the leaf on which they reſt, receive the leaſt ſhock, they roll themſelves up and fall off. They

enter

enter the earth to the depth of from one to four inches, and the proceſs of transformation goes on as related above.

Frequently as ſoon as the ſkin is ſhed, they are ſeen feeding upon it; this appears to be an inſtinctive act, and perhaps contributes to furniſh a more copious ſupply of the viſcous exudation; but the laſt mucous ſkin which is thrown off remains extended on the leaf, as at *fig.* 2. c, and ſuch ſkins have been miſtaken for dead ſlugs.

On the 12th of July, perceiving many in the yellow ſkin, I directed cloths to be ſpread on the ground and the trees to be ſhaken; About 170 were collected which I threw into a veſſel filled with light earth. On the 30th, or in eighteen days after their deſcent into the earth they began to riſe in the form of flies.

I was then unexpectedly called from home, and was abſent through the months of Auguſt and September. At my return, in October, the ſlugs of the ſecond hatch were in plenty on the trees, and ſome of them remained till the 21ſt, a month later than in the preceding year, when almoſt all the leaves had fallen and after having ſurvived ſeveral froſts.

They had been far more numerous in the firſt hatch, than they were in 1796; but according to the beſt information I could collect, their numbers in the ſecond greatly exceeded the firſt: the ſmall trees were covered with them; and a breeze of air paſſing through the trees, became charged with a very diſagreeable and almoſt ſickening odour.

In order to determine, with ſome degree of preciſion, the time when the fly firſt riſes in the ſpring, I filled a box with earth taken from the foot of a cherry tree, from one to four inches deep, in the month of February of the preſent year. It contained about two cubic feet. This earth I cauſed to be ſifted, and by this means 190 cells were collected, which were put with ſome of the ſifted earth in a garden pot. At the ſame time I examined the earth in which the larvæ of the firſt hatch of the laſt year had paſſed their transformation; and finding

finding many cells whole, ſuppoſed the larvæ within them had periſhed; but on opening ſome of them, I found they were alive, and in the ſame ſtate as on their firſt entrance. I examined both parcels of earth again on the 6th of May: the larvæ had then juſt entered the pupa ſtate in both. It appears hence that if all the Slugs of the laſt hatch of 1797 had been deſtroyed on the trees, there would have remained in the earth a ſufficient number to have continued the ſpecies.

On the 21ſt of May they began to riſe and depoſite their eggs. About the 5th of June the young Slugs began to ſhew themſelves, and continued to do ſo in great numbers, till towards the end of the month; and it appeared, that the flies not only roſe earlier; but that they continued to riſe and depoſite their eggs longer this year than in the two former years.

In the beginning of July the larvæ began to deſcend; about the 23d, the flies from theſe began to riſe, and by the 7th of Auguſt the Slugs of the ſecond hatch began to appear on thoſe trees which had any green leaves remaining, in ſuch abundance that by the 15th there were from twenty to thirty on a ſingle leaf. In the mean time the trees which had been ſtripped, had thrown out new leaves, at the ends of thoſe branches that had not periſhed, from buds, which ſhould not have unfolded, according to the uſual courſe of vegetation, till the next ſpring; thus anticipating the growth of one year, and cutting off the proſpect of fruit.

As the flies continue to depoſite their eggs about three weeks, and the period of hatching is as long, the Slugs are conſequently of different ſizes: the larger diſappear leaving the ſmalleſt on the leaves. Hence, ſome perſons have ſuppoſed there were three or four hatches in a year; but there are certainly only two.

Heavy ſhowers are ſaid to deſtroy them, and it is poſſible that a few may be waſhed off; rain appears to be diſagreeable to them, and, in ſhowers, I have obſerved that they make a ſafe retreat to the under ſide of the leaves.

They ſeem to prefer different trees in different places. In my neighbourhood the common red Cherry was more attacked, than the Plumb or Pear: in a garden about a mile diſtant, they ſeemed more pleaſed with the Quince, than with the Pear, Cherry or Plumb: In another place the Button-Pear was preferred to any other. I have alſo found them on the wild Black-Cherry and wild Pear.

The largeſt ſlugs that I have ſeen, were about 9-20ths of an inch in length. The head of a dark cheſnut colour, is bent under and entirely concealed *(fig. 3 & 4.)* This conformation is neceſſary as the direction of its bite is in the plane of the leaf; but when it has aſſumed the yellow coat, its head is more prominent and diſcernible *(fig. 2. b. & fig. 5.)* The ſix firſt feet are terminated with a little hook; beſides theſe there is a limb on each ſide, between the firſt pair of feet and the head, which is unarmed, and always laid over the ſide of the face juſt below the eyes. I have not obſerved any thing analogous to theſe in any other larva; they are ſhewn at *fig. 4. a*: their uſe may perhaps be to regulate the depth of its bite, and to wipe off any extraneous particles that may adhere to the jaws or antennæ. The other fourteen feet are entirely unarmed *(fig. 3. b.)* It is mechaincally ſupported by the former; but its ſupport by means of the latter appears to depend on the preſſure of the atmoſphere.

Their body is largeſt towards the head, and diminiſhes gradually toward the tail. They have the faculty of ſwelling out the anterior part of the body (as in *fig. 2. a. & fig. 3.*), and they moſt frequently appear in this manner with the tail a little turned up *(fig. 2. a)*.

The cell is repreſented at *fig. 7*; the pupa is yellowiſh, the eyes brown and is delineated at *fig. 6.*

The fly is of *a full gloſſy black except the legs which are of a browniſh aſh colour:* the antennæ black with nine articulations. It is repreſented at *fig. 8. a*, of its natural ſize, and magnified at *fig. 8. b.* The wings are tranſparent, with a ſooty tinge, reflecting the priſmatic colours when held in certain directions to the light. They are a little tumid or convex on the upper ſide, which is one characteriſtic of this genus; but a more certain one is the

the ſting, or inſtrument with which the female makes the inciſion for the reception of her eggs. This reſembles a ſaw, and from this circumſtance they are called by Engliſh writers Saw-flies. One of the anterior and poſterior wings is ſhewn at *fig.* 9. The male reſembles the female in colour; but is conſiderably leſs and has no ſting. A part of the abdomen of the female, containing the ſting, is ſhewn at *fig.* 10; and the correſponding part of the male at *fig.* 11.

In the thirteenth edition of the Linnean Syſtem, by Profeſſor Gmelin, there are 142 ſpecies of this genus, of which the Tenthredo Cerafi or Saw-fly of the Cherry-tree, has the greateſt affinity to the Slug-fly; and is deſcribed as being "*black, with the legs and triangular part on the* "*back, between the inſertion of the wings, yellow. The* "*larva ſlimy and black, inhabits the leaves of the Cherry* "*tree, which it rolls up.*"*

The Slug-fly has no yellow about it, neither does the larva roll up the leaves: it may, notwithſtanding, be a variety of the Tenthredo Cerafi, as it agrees in ſize and in the ſlimy covering.

An eminent French author, on the ſubject of inſects, has a figure of the fly and of the larva; but deſcribes only the latter, which he calls the Falſe Caterpillar of the Pear-tree. In his deſcription he ſays, "Another kind of "falſe caterpillar, which differs very much from the com- "mon kind in form and which it is difficult to character- "ize is found on various fruit-trees, as the Plumb, the "Cherry, but eſpecially on the Pear-tree. Fruit-trees "however are not the only ones on which they are found; "for I have alſo ſeen them upon Oaks. In both they "live on the upper ſurface of the leaves, and there con- "ſume the parenchyma; their ſkin is always mucous, "which would make them to be taken for ſnails, if one "did not perceive their feet. Their colour is a brown- "green. They are rarely ſtretched out like the Cater- "pillar, and can at pleaſure ſwell a certain part of their "body: they frequently ſwell the fore part for a third "of

* Syſtema Naturæ, pa. 2659. no. 20.

" of its length or more, and narrow the reſt. They have " but twenty feet and none in the laſt ſegment. Theſe " inſects ſometimes multiply exceedingly on the Pear- " tree, ſo that four or five are found on the ſame leaf. " I have ſeen of theſe trees in the month of July without " a green leaf."†

THIS deſcription, according ſo exactly with the Slug, and the author's mentioning it as a ſingular ſpecies, incline me to believe that it is the only ſpecies of this genus which has a mucous coat, and that our Slug-fly is a variety of the Tenthredo Cerafi. The form of the ſaw in the European ſpecies will determine this point.

THIS inſtrument is a very curious object, and in order to deſcribe, it will be proper to compare it with the tenon-ſaw uſed by Cabinet-makers; which being made of a very thin plate of ſteel is fitted with a back to prevent its bending. The back is a piece of iron, in which a narrow and deep groove is cut, to receive the plate, and is fixed; the ſaw of the Tenthredo is alſo furniſhed with a back, but the groove is in the plate and receives a prominent ridge of the back which is not fixed, but permits the ſaw to ſlide forward and backward as it is thrown out or retracted. The ſaw of artificers is ſingle, but that of the Tenthredo is double, and conſiſts of two diſtinct ſaws with their backs; the inſect in uſing them, firſt throws out one, and while it is returning, puſhes forward the other, and this alternate motion is continued till the inciſion is effected; when the two ſaws receding from each other, conduct the egg between them into its place. In the artificial ſaw the teeth are alternately bent toward the ſides, or out of the right line, in order that the fiſſure or kerf may be made ſufficiently wide for the blade to move eaſily: to anſwer this purpoſe in ſome meaſure, in that of the Tenthredo the teeth are a little twiſted ſo as to ſtand obliquely with reſpect to the right line, and their points, of courſe, project a little beyond the plane of the blade, without being laterally bent, and all the teeth in each blade thus project a little outward; but the kerf is more effectually made, and a

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† Reaumur in Mem. des Inſectes. Tom. 5. Mem. des Mouches à ſcie.

free range procured for the ſaws, by ſmall teeth placed on the outer ſide of each; ſo that while their vertical effect is that of a ſaw, their lateral effect is that of a raſp. In the artificial ſaw the teeth all point outward and are ſimple; but in the ſaw of the Tenthredo, they point inward or towards the handle, and their outer edge is beſet with ſmaller teeth which point outward. Some idea of the ſaw as connected with its back may be formed from *fig.* 12, and of the ſaw alone from *fig.* 13. The lateral teeth in the ſaw of the Slug fly are very minute, and the want of light, when the greateſt magnifiers are uſed to examine a flat ſurface, has prevented my ſeeing them ſufficiently well defined, to be able to expreſs them accurately, though the contour of the object is very diſtinct, but viewed edgeways they are plainly ſeen. I have therefore given *fig.* 14. of one from another ſpecies inhabiting the cherry-tree, which ſhews this part of the ſtructure very plainly.

I KNOW not how long the flies continue to live after their firſt appearace; though plenty about the trees, in the time of depoſiting their eggs, they become, afterwards, very ſcarce. I am equally uncertain as to the number of eggs from a ſingle fly. If all in the ovaria come to perfection, a ſingle fly may depoſit between two and three hundred; but probably not more than half theſe are excluded by the fly. The ovaria are compoſed of ſeveral tubes, about ſix on each ſide, which occupy a great part of the abdomen, flowing from a common point, enlarging in their courſe and uniting again on each ſide, in a canal leading to the oviduct. (ſee *fig.* 15.) The eggs in theſe tubes are of all intermediate magnitudes, from a ſcarce viſible ſpeck to thoſe ready to be excluded, of which laſt I have frequently counted fifty, though the ſeaſon of depoſiting was advanced.

THE flies do not feed like moſt inſects of this claſs, on the honey of flowers; but upon the moiſture which they lick up from the leaves, moiſt with dew or ſhowers.

THE viſcous coat of the Slugs ſeems to be their ſufficient defence in the larva ſtate; they are not, however, without

without enemies, and such as I hope will be a considerable check upon the increase of this very disagreeable and destructive insect.

In prosecuting my inquiries the last year, I observed some eggs in the leaves of the Cherry-tree, which were not semitransparent; but opaque and black; concluding they were abortive, and desirous to know the cause, I examined them and found each egg occupied by two or three white specks: these were so many insects in the pupa state, one of which is represented at *fig.* 16, and I afterwards found the perfect insect which is shewn at *fig.* 17. This is an extremely small fly of the genus Ichneumon, which deposits its eggs in those of the Tenthredo and other insects. *It is of a pale rust colour; the eyes and three spots* (stemmata) *on the top of the head, of a bright red; the wings transparent, studded and fringed with fine bristles, the posterior wings very narrow; the antennæ consisting of 5 articulations.* I observed this year that great numbers of the eggs of the Slug-fly, especially of the second hatch, were rendered abortive by this atom of existence. The out line of the egg of a Slug fly at *fig.* 18, magnified to the same degree as *fig.* 16 & 17, will enable you to judge of their comparative magnitudes.

I CANNOT but remark here, how just was the observation of a naturalist who lived in the first century, and how amply it is confirmed by the microscopes of the moderns, "that the author of nature is no where more perfect than in the minutest of his works!"

To make this account as perfect as I was able, I have noted every particular which has come to my knowledge; this has rendered it prolix: but I hope the satisfaction you may receive, will, in some measure, compensate for the fatigue of going through it.

I BEG you to believe me to be, with much respect,
Sir, your most obedient servant,
Massachusetts, August—1798— RURICOLA.

N. B. The above History obtained the Agricultural Society's premium of Fifty Dollars and the Gold Medal. ☞ *The preserved specimens, referred to in the History, may be seen by calling on the Corr'g. Secretary.*